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ABSTRACT

In this study, models were constructed for eight academic areas, including applied sciences, communication sciences, education, physical sciences, life sciences, humanities and arts, psychology, and social sciences, to predict whether or not an at-risk graduate student would be successful in obtaining a master's degree. Records were available for 916 graduate students who were considered at risk because they did not meet the minimum admission requirements but were given the opportunity to begin coursework. Success was measured in two ways: (1) whether or not the student completed the degree; and (2) categorization of the graduate grade point average obtained after 9 hours of graduate coursework as either 3.5 or above or below 3.5. The predictor variables included Graduate Record Examination (GRE) scores, undergraduate grade point average, Carnegie classification of the student's undergraduate institution, and personal variables. GRE scores were combined with undergraduate grade point averages as compensatory and conjunctive to determine the best predictor for each area. The accuracy of prediction using the logistic regression models ranged from 63 percent to 84 percent. (Author/EV)

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Admission Models for At-Risk Graduate Students in Different Academic Disciplines

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Abstract

In this study, models were constructed for eight academic areas, which included applied sciences, communication sciences, education, physical sciences, life sciences, humanities and arts, psychology and social sciences, to predict whether or not an at-risk graduate student would be successful in obtaining a Master's degree. Records were available for 916 graduate students who were considered at risk because they did not meet the meet minimum admission requirements, but were given the opportunity to begin coursework. Success was measured in two ways: 1) whether or not the student completed the degree, and 2) categorization of the graduate grade point average obtained after 9 hours of graduate coursework as either 3.5 or above or below 3.5. The predictor variables included the graduate record examination scores, the undergraduate grade point average, Carnegie classification of the student's undergraduate institution, and personal variables. The graduate record examination scores were combined with the undergraduate grade point averages as compensatory and conjunctive to determine the best predictor for each area. The accuracy of prediction using the logistic regression models ranged from 63% to 84%.

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Admission Models for At-Risk Graduate Students in Different Academic Areas

Objectives and Theoretical Framework

Department admissions committees of master's level graduate programs are faced with the task of admitting students who have the greatest potential for success. Usually there are students for whom either their undergraduate record or their Graduate Record Examination (GRE) scores indicate that they may be at-risk for further academic work. Some students who have a rather poor undergraduate record are admitted to graduate school and become outstanding graduate students. Students with less than distinguished academic backgrounds may, in fact, have exemplary performance in a job setting. Thompson and Kobrak (1983), when predicting the success of students in a Masters of Public Administration program, suggested that it was not necessary to "accept any person who comes to us regardless of academic back-ground, but particularly for a discipline that prides itself on working with practitioners, it does require that we examine them on the basis that they appear before us" (p. 182). Other students who are at-risk for success in graduate school do not perform satisfactorily. These students use the resources of the institution that may benefit a more capable student. Such students who are not capable of graduate work may consume disproportionate amounts of faculty time. Even worse, professors may lower their expectations in courses to accommodate these students. The objective of this study was to establish prediction models for different academic areas that may serve to select graduate students who are the most likely to succeed.

It seems logical that different academic disciplines would require different skills. A Master's degree that is regarded as a practitioner's degree has skill requirements which differ from a Master's degree that is highly theoretical. Thornell and McCoy (1985) examined the predictive validity of the Graduate Record Examination (GRE) and the graduate grade point average (GGPA) for subgroups of students in different disciplines and found variations in the coefficients of correlation between GRE components and GGPA for different disciplines. Twenty years earlier in a study by Madaus and Walsh (1965), differing Beta weights for regression equations were determined for students in different areas Later, studies by Nelson and Nelson (1995) and Nelson, Nelson and Malone (2000) found that the area of study was itself a predictor of success for at-risk students in graduate work.

How does one measure success in graduate school? In the studies by Thornell and McCoy (1985) and Madaus and Walsh (1965), success in a graduate program was measured by GGPA. Studies by Thompson and Kobrak (1983) and Mitchelson and Hoy (1984) used completion of the degree as the measure of success in graduate

school. The studies by Nelson and Nelson (1995) and Nelson, Nelson and Malone (2000) used both GGPA and degree completion as measures of success in graduate school. Thus, two criteria may be utilized for measuring success: 1) completion of the degree; 2) GGPA. While these two measures are positively correlated, (a student must maintain a minimum grade point average to remain in a graduate program), a high grade point average does not insure that a student will complete the degree requirements. For graduate programs that have spaces for students, but do not want to admit students whose probability of completing the requirements is low, a prediction of the completion of the degree is appropriate. For graduate programs, where the number of students that may enroll is restricted, GGPA may be the better criterion.

Thompson and Kobrak (1983) suggested that the primary variables that predict success in a graduate program are perceived to be intelligence and commitment. Mitchelson and Hoy (1984) labeled these variables as intelligence and motivation. Madaus and Walsh (1965), in noting the coefficient of multiple determination (the R squared statistic) as being quite low in their study of predicting GGPA from GRE scores, suggested that "other factors probably include differences in student motivation, in previous training and in personality factors" (p. 1108). Obviously, the problem is to find ways of assessing the variables of intelligence and motivation. Two such measures are undergraduate grade point average (UGPA) for motivation and GRE scores for intelligence. These variables, of course, may be correlated.

One assessment of previous training is the Carnegie classification of the institution where the student received his/her undergraduate degree. Under the Carnegie classification scheme, institutions are classified as research, doctoral degree granting, master's degree granting, and baccalaureate degree granting.

Mitchelson and Hoy (1984), in considering measurements of intelligence and motivation, suggested that additive or compensatory models, i.e., intelligence + motivation, might not be adequate. If GRE scores are considered as a measurement of intelligence and UGPA a measurement of motivation, motivation alone may not compensate for a lack of innate ability. In the additive model, high motivation may compensate for low intelligence and vice versa. Einhorn (1970) described a subjunctive model, which may be more appropriate. In this model, standardized measures were multiplied instead of being added. In the application of the subjunctive model, intelligence x motivation, high motivation could not compensate for a weak intelligence factor, nor could intelligence compensate for a lack of motivation. In the current study, both subjunctive and compensatory models were utilized.

This study was conducted at a medium-size Midwestern University with an average total enrollment of 17,500 students, including a graduate enrollment of 2600 students. The subjects in the study came from those students who applied to graduate school for the years 1987-1999 who were defined as at-risk or probationary, and were United States citizens whose first language was English. International probationary students were not included because these students were not required to take the GRE, one of the criteria used to determine whether or not a probationary student could be granted full admission to a graduate program. A graduate student was considered to be at-risk if the undergraduate grades did not meet the minimum admission requirements of the university, i.e., the cumulative UGPA was less than 2.75 and the latter-half of baccalaureate work was less than 3.0 on a four point grading scale. All probationary students, if supported by their academic departments, completed a nine-hour directed plan of study. Departmental admissions committees used the grades from those three courses and GRE scores to determine if full admission to graduate study was warranted.

Procedures and Methodology

Seven general areas of study were considered and are listed below. The number of students granted probationary status to the specific areas for which complete records were available is provided in parentheses:

1. Applied sciences (212)
2. Communication sciences (168)
3. Education (212)
4. Physical sciences (84)
5. Life sciences (77)
6. Humanities and arts (37)
7. Psychology (39)
8. Social sciences (87)

Two dependent variables were analyzed in this study. The first dependent variable was completion or non-completion of the degree. A student who had not completed the Master's degree and had not taken coursework within one year of this study was assumed to be inactive and was placed in a non-completion category. Students who successfully completed the Master's degree were coded as a "1" and those who did not complete the degree were coded as a "0." The second variable was GGPA calculated after nine semester hours of graduate course work. The choice for nine hours was based not only on institutional requirements for probationary students but on previous research. Kingston (1985), Nelson and Nelson (1995), Nelson, Nelson, and Malone (2000), Rhodes (1994), Thompson & Kobrak (1983), and Vaseleck (1994) discovered no significant difference in GGPA in a student's first nine semester hours or first year of graduate study and the student's GGPA at the completion of the graduate course of study. Since most of the grades earned by students in graduate work are either "As" or "Bs",

there is a narrow variance in the GGPA. Therefore, the GGPA was dichotomized. A GGPA of 3.5 or higher was coded as a "1" , and a GGPA of less than 3.5 was coded as a "0." While the categories may be somewhat arbitrary, it should be noted that a GGPA of above 3.5 indicated that the graduate student earned more "A" grades than grades lower than "A", while a GGPA of less than 3.5 indicated a somewhat weaker academic record.

The predictor variables fell into two categories: 1) continuous, and 2) categorical. The continuous predictor variables included UGPA, the GRE verbal (GREV), the GRE analytic (GREA) and the GRE quantitative (GREQ) scores. A linear transformation was performed on the GRE scores to put these scores on the same scale as UGPA. The products UGPA x GREV, UGPA x GREA and UGPA x GREQ were included as the conjunctive part of the model.

The categorical variables included gender, race, and the Carnegie classification of the institution that granted the undergraduate degree to the student. The institutions were categorized as research, doctoral level, master's level, baccalaureate, and other. Deviation contrasts were constructed to compare the research, master's level, baccalaureate and other institution category with the doctoral category.

The backward stepwise logistic regression procedure of SPSS, release 6.1, for a DEC Alpha computer running VMS version 7.1 was used to predict the dependent variables for each of the academic areas from the predictor variables described above. The criterion for removal of a variable from the model was the change in significance of the log likelihood ratio when the variable was eliminated from the model.

Findings

Table 1 displays the Beta weights and, in parentheses, the significance of these weights for each of the academic areas for predicting completion of the Master's degree. No entry in a particular cell indicates that the variable was not a significant predictor of successful completion of the degree. Such variables were eliminated when the stepwise regression was performed.

Table 1

Stepwise Logistic Regression for Successful Completion of the Master's Degree

Predictor variable	Appl. Sci.		Comm.		Educ.		Hum/Arts		Life Sci.		Phys. Sci.		Psych.Sci		Soc. Sci.	
	Beta	Sig	Beta	Sig	Beta	Sig	Beta	Sig	Beta	Sig	Beta	Sig	Beta	Sig	Beta	Sig
Race													-3.96	.02		
Gender			-0.47	.21			1.97	.12					-1.67	.04		
Institution type		.09						.24								
Contrast 1	-1.55.	.55					2.38	.05								
Contrast 2	-0.31	.90					-0.74	.61								
Contrast 3	-1.41	.59					.51	.61								
Contrast 4	5.09	.62														
UGPA			-19.35	.07									217.21	.01		
GREV					-0.08	.01	-0.26	.15	.16	.01	.05	.10	.32	.06		
GREA			.0045	.06	.08	.01	-0.30	.05	-0.17	.01	-0.04	.11	.29	.08		
GREQ			-0.05	.08			.58	.02							.01	.00
GREV*UGPA	.54	.04			9.42	.01	32.83	.12	-20.46	.01	-5.34	.11	-38.41	.06		
GREA*UGPA	-0.55	.00			-9.32	.00	36.17	.05	20.65	.01	5.00	.11	-32.55	.09		
GREQ*UGPA			6.43	.09			-69.93	.02								
Constant	2.45	.39	26.43	.07	0.25	.88	-4.70	.49	-0.26	.91	.11	.95	-313.05	.01	-3.75	.00

The regression equations whose weights are given in Table 1 produced the percentages of successes displayed in Table 2.

Table 2

Logistic Regression Results for Prediction of Completion

	Applied Sciences		
	Predicted		
	Non-completion	Completion	Percentage
Observed			
Non-Completion	12	57	17.39
Completion	7	136	95.10
		Overall accuracy	69.81

(Table 2 continued)

Communication Sciences

	Predicted Non-completion	Completion	Percentage
Observed			
Non-Completion	3	35	7.89
Completion	2	128	98.46
		Overall accuracy	77.98

Education

	Predicted Non-completion	Completion	Percentage
Observed			
Non-Completion	5	48	9.43
Completion	3	146	97.99
		Overall accuracy	74.75

Humanities and Arts

	Predicted Non-completion	Completion	Percentage
Observed			
Non-Completion	14	3	82.35
Completion	3	17	85.00
		Overall accuracy	83.78

(Table 2 continued)

Life Sciences

	Predicted		
	Non-completion	Completion	Percentage
Observed			
Non-Completion	14	15	48.28
Completion	8	40	83.33
		Overall accuracy	70.13

Physical Sciences

	Predicted		
	Non-completion	Completion	Percentage
Observed			
Non-Completion	19	21	47.50
Completion	10	34	77.27
		Overall accuracy	63.10

Psychology

	Predicted		
	Non-completion	Completion	Percentage
Observed			
Non-Completion	12	5	70.59
Completion	4	18	81.82
		Overall accuracy	76.92

Social Sciences

	Predicted		
	Non-completion	Completion	Percentage
Observed			
Non-Completion	17	17	50.00
Completion	10	43	81.13
		Overall accuracy	68.97

For each academic area, the model created for the area was at least 75% accurate in predicting the students who would finish the program and obtain the Master's degree. The accuracy in predicting those students who would not complete the degree was particularly weak in communication sciences and education.

The second set of analyses was performed to predict the dichotomized grade ("0" GGPA < 3.5, "1" GGPA >= 3.5) from the same predictor variables. Table 3 gives the Beta weights and the significance of these weights for each of the academic areas.

Table 3

Stepwise Logistic Regression for Prediction of Dichotomized GGPA

Predictor	Appl. Sci.		Comm.		Educ.		Life Sci.		Phys. Sci.		Psych.Sci		Soc. Sci.	
variable	Beta	Sig	Beta	Sig	Beta	Sig	Beta	Sig	Beta	Sig	Beta	Sig	Beta	Sig
Race			.79	.05	.58	.03					1.36	.04		
Gender	.34	.03			.30	.07								
Institution type												.38		
Contrast 1											7.11	.78		
Contrast 2											-1.97	.82		
Contrast 3											-1.71	.84		
Contrast 4														
UGPA			-18.96	.03										
GREV	.0061	.00	-0.045	.06			.15	.01					.0057	.07
GREA									-0.08	.03			.0060	.03
GREQ							-.15	.01	.07	.04				
GREV*UGPA			6.50	.03	.47	.02	-17.41	.01						
GREA*UGPA									10.03	.03				
GREQ*UGPA							17.48	.01	-8.67	.04				
Constant	-1.83	.01	21.08	.06	-2.60	.06	-0.58	.80	-6.82	.00	2.15	.80	-5.43	.00

The area of humanities and arts was not included in Table 3 since the significance of the Beta weights was weak. This academic area does not admit many probationary students. Furthermore, it is difficult to compare student grades for private lessons in music with student grades in a classroom setting. The results of applying the logistic equations to the remaining academic areas is presented in Table 4 below.

Table 4

Logistic Regression Results for Prediction of GGPA

Applied Sciences

	Predicted		
	< 3.5	>= 3.5	Percentage
Observed			
< 3.5	18	59	23.38
>=3.5	16	119	88.15
		Overall accuracy	64.62

Communication Sciences

	Predicted		
	< 3.5	>= 3.5	Percentage
Observed			
< 3.5	78	20	79.59
>= 3.5	33	38	53.52
		Overall accuracy	77.98

Education

	Predicted		
	< 3.5	> = 3.5	Percentage
Observed			
< 3.5	6	48	11.11
> = 3.5	6	142	95.95
		Overall accuracy	73.27

(Table 4 continued)

Life Sciences

	Predicted		
	< 3.5	> = 3.5	Percentage
Observed			
< 3.5	8	20	28.57
> = 3.5	4	45	91.84
		Overall accuracy	68.83

Physical Sciences

	Predicted		
	< 3.5	> = 3.5	Percentage
Observed			
< 3.5	24	16	60.00
>= 3.5	11	33	75.00
		Overall accuracy	67.86

Psychology

	Predicted		
	< 3.5	> = 3.5	Percentage
Observed			
< 3.5	5	9	35.71
> = 3.5	1	24	96.00
		Overall accuracy	74.36

(Table 4 continued)

Social Sciences

	Predicted		
	< 3.5	> = 3.5	Percentage
Observed			
< 3.5	29	14	67.44
> = 3.5	15	29	65.91
		Overall accuracy	66.67

Except for communication sciences, the models were more than 60% accurate in predicting students who would have a GGPA of 3.50 or above. The accuracy in predicting GGPA below 3.5 was highest for communication sciences.

Summary and Conclusions

No model can predict with 100% accuracy which graduate students will be successful and which graduate students will not be successful. Students may have to discontinue their graduate studies for health or family reasons. Candidates who show great potential may lose interest in their studies and perform poorly. However, we do have measures of performance when analyzed collectively that can help in predicting success and give an academic area some basis for either admitting or rejecting a candidate.

In predicting whether or not a candidate will complete the Master's degree, the GREV was a predictor in five of the eight academic areas under study, while the GREV combined conjunctively with UGPA as a predictor in six of the eight areas. The conjunctive combination of the GREV with UGPA predicted variance that could not be predicted by the GREV alone. While UGPA was only a significant predictor of success in two of the eight areas, the conjunctive combination with one or more of the GRE scores with UGPA was a significant predictor in seven of the eight areas. It may be the case that students in communication sciences enrolled in that area because they possess communication skills and the GREV or the conjunctive combination of the GRE with UGPA does not predict a significant amount of the variation among these students. Certainly, writing skills are important to success in graduate work, and this accounts for the fact that the GREV, either alone or in combination with the UGPA, is a significant factor in predicting degree completion.

The type of institution from which the student received the undergraduate degree was a significant predictor in only applied sciences and humanities and arts. One argument may be that in the other academic areas, the undergraduate preparation may be uniform among the types of institutions, while in applied sciences and humanities and arts, the curricula may differ among institutions.

A study of Table 1 does indicate that while there are some common factors among the eight areas, a different model should be created for each area. In fact, a refinement of the model for physical sciences should be done for a specific discipline within the area, for example mathematics.

The logistic models presented in Table 1 produced the prediction percentages given in Table 2. The overall accuracy ranged from a low of 63.1% for the physical sciences to a high of 83.8% for humanities and arts. For those students who actually completed the degree, the accuracy ranged for 77.3% to 98.5%. However, the prediction accuracy was lower for students who did not complete the degree. This accuracy extended from a low of 7.9% to a high of 70.6%. Thus, the prediction error is in the right direction: it is better to admit a student who does not complete the degree, than to deny a student who would complete the degree.

It is noteworthy that if success is measured by the dichotomized GGPA, as opposed to completion or non-completion of the degree, the predictors differ and the Beta weights of the predictors that are the same for both dependent variables differ. This is evident from comparing Table 1 with Table 3. The overall prediction of success as displayed in Table 4 ranged from 64.6% to 78% which is not greatly different from the success rate shown in Table 2. For students who were in the higher GGPA classification, the accuracy of the prediction ranged from a low of 53.5% to a high of 96%. The poorest prediction for students who were in the higher GGPA classification was in communication sciences. However, of the students who actually were in the lower GGPA category, the prediction was the highest (80%) for students in communication sciences. Again, it is better to predict that a student will be in the higher GGPA category who actually performs in the lower category, than to predict that a student will perform in the lower category who actually has a GGPA at or above 3.5.

While admission of a student to a graduate program should be a decision that rests with the department, the overall model suggested by Nelson, Nelson and Malone may be appropriate for screening students who should not be admitted to any graduate program. The department may then make a decision concerning the students who are initially accepted for graduate study.

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